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ENVIRONMENTAL HEALTH SERIES

Radiological Health

SCIENTIFIC INFORMATION RETRIEVAL SYSTEM FOR RESEARCH GRANTS

Division of Radiological Health

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

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ENVIRONMENTAL HEALTH SERIES

This series of reports embraces the science and technology of creating and maintaining a healthful environment for man. Individual reports in the series deal with health factors in: Air; water; food; chemical, biological, and radiological contamination; sound, vibration, and X-radiation; liquid, solid, and gaseous wastes; homes, places of employment and recreation, and institutions.

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SCIENTIFIC INFORMATION RETRIEVAL SYSTEM FOR RESEARCH GRANTS

Division of Radiological Health

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Public Health Service
Division of Radiological Health
Washington, D.C. 20201

Library of Congress catalog card number 66–62103

Public Health Service Publication No. 999–RH–22

October 1966

U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON : 1966

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PREFACE

Easy access to recorded information has become increasingly necessary to our technically oriented society. Because of the need to meet requirements for specific items of information, it has become necessary to design specialized retrieval systems with capacities beyond those of reference retrieval systems such as library cataloging or other indexing systems. The information retrieval system discussed in this report was developed and put into operation in December 1964. For the purposes of the report, the term "information retrieval" is intended to denote a capacity to retrieve factual material from the contents of documents available to the system.

It is emphasized that the objective was not merely to establish a coding system, of which there are a great variety. Rather, the aim was to produce a system permitting access to information from more than one direction. The criteria for the system were carefully laid down, and its operation was checked to assure that these criteria were met.

This report describes a system that is specifically suited to the requirements of the Research Grants Staff of the Division of Radiological Health. It is, however, compatible with, and convertible to, operations of greater scope and complexity.

It is presented to aid those who are interested in developing information retrieval systems that can be installed quickly, used with a minimum of hardware, and yet be suitable for incorporation into more sophisticated information retrieval systems should growth of the organization require such expansion.

ABSTRACT

A method developed for the Division of Radiological Health research grants for use in retrieving scientific information readily by means either of a manual system or an automatic information processing system, or a combination of the two, is described. The principles of the method are applicable or adaptable to other programs in which scientific information retrieval is required. The system described is based on the special experiences of the Division of Radiological Health Research Grants Staff and applies to the problems characteristic of its operations. Specific examples of coding and searching are given, with special attention to needs related to program and discipline areas, as well as to scientific content.

SCIENTIFIC INFORMATION RETRIEVAL SYSTEM FOR RESEARCH GRANTS

Division of Radiological Health

INTRODUCTION

In October 1964, it became apparent that for administrative, accounting and technical purposes, a system would have to be developed to retrieve scientific data evolved from research grants projects. For the special needs of the Division of Radiological Health, it was necessary to devise a means for extracting useful information contained in the research report or in the protocol. In many instances, it is desirable to include subject material ancillary to the program design. Such material would be buried or lost if reliance were placed only on key words in the title or on broad categories of subject matter.

This information, even if of a privileged nature, is useful as a guide to research progress and as an aid in evaluating grant programs in related areas of investigation. Where the information is not privileged, it may be disseminated or used as a guide by other interested persons.

Various aspects of the problem were considered by the Research Grants Staff, and a general working system arrived at after considerable experimenting. In the initial phase, at least, the system was to be a manual operation. It was required that the coding be flexible enough to provide for scientific and administrative document retrieval. Some of the procedures used for administrative purposes have been automated.

The system developed was designed especially for application to operations in which scientific information is generated and must be organized in an orderly fashion to permit easy and rapid retrieval of the information. The specific coding chart or method used, however, would not necessarily be applicable to the operations of some other types of programs. In each case the coding should be compatible with the particular areas of research interest.

The same coding can at a later date allow for conversion from a manual system to automatic processing.

CRITERIA FOR SYSTEM DESIGN

The Research Grants Staff of the Division of Radiological Health is authorized to fund grants in specific areas of radiological health research. Provisions for such authorizations of grants are outlined in the Research Grants Manual. From this manual, a research area index was evolved, outlining the areas in which the Division would support grant applications. This index was used as the basis for the construction and operation of the coding system.

The system was designed to provide the following: (1) technical control, for use in determining whether there were other grants or grant applications dealing with work in the same or related fields; (2) research grants content-information retrieval, privileged, for administrative control; and (3) research grants content-information retrieval "open" (not privileged), to be used for rapid dissemination of scientific findings resulting from research in progress, work completed, and data available for distribution but not yet in the open literature, or work that has appeared in a document of limited distribution.

More specifically, the system may be described as having been designed to provide for the following:

1. *Technical Control*
   a. Analysis of "Summary of Progress" reports with evaluation of the content by the program staff.
   b. Summarization of all reprints submitted under the grant with evaluation of their significant data content.

2. *Research Grants Content-Information Retrieval, Privileged*
   a. Avoidance of inadvertent duplication in funding new grants.
   b. Evaluation to determine whether continued support should be advised when the investigator has completed the initial project.
   c. Assurance that progress is being made by the investigator.
   d. Evaluation to determine whether there has been a significant change in research effort direction without prior advice to the program director and receipt of written consent.
   e. Extraction and review of information from the progress

report submitted, with due consideration of its privileged nature, for relationship to various Division interests. This information would be useful in replying to requests of branches in the Division to see if work has been done in a specific area, and whether significant results have been obtained. The requesting branch can be referred directly to the investigator if detailed information is needed.

3. *Research Grants Content-Information Retrieval, Open*

Materials in this category allow dissemination of scientific findings contained in reprints submitted in accordance with research grants procedures. This requirement is especially important where publication has occurred in a little-known periodical, in a report of limited distribution, or has not been published. The information is summarized and notes made of the significant data. This information is then utilized as follows:

a. Provision of the latest information to the branches of the Division. This information may not as yet have appeared in any of the abstract services and thus not be readily available to them.

b. The alerting of a branch of the Division to some significant finding arising from research supported by this program. The branch, quarterly or more often, receives a listing of these reprints, copies of which are also supplied to the Division Library. The system is used with great regularity.

DESCRIPTION OF THE SYSTEM

The information retrieval system is keyed to certain basic organizational documents. These provide the indices required to operate the system, and consist of the following:

1. *Research Areas Supported by the Division of Radiological Health*

The areas, categories, and subcategories of research interests are those that the Division is willing and authorized to support. The indices provided can be as elaborate or as simple as reqiured, but should be realistic and in accordance with established policy.

2. *Content of Areas Supported by the Division*

This document provides particulars on the scope of each area, category and subcategory, and cites any exceptions. It is used in preparing the structure of the code, and it is the essential guiding document in determining the coding for a given research subject.

3. *Source Document*

This document is the basis for coding the grant application, the progress report, and any other item that requires coding and provides an orderly format for this purpose.

For direct operational purposes, the following items come into consideration:

1. MATERIALS INDEXED AND CODED

a. *Initial Grant Application.* This is a privileged document.

b. *Notice of Research Proposed.* This was formerly referred to as Scientific Information Exchange (SIE). This is restricted to limited distribution and used for internal control

c. *Yearly Progress Report.* This is a privileged document.

d. *Terminal Progress Report.* By research grants regulations, the principal investigator is required to submit a final progress report within 6 months after the termination of the project. If a report on the investigation has not been accepted for publication, it becomes available for dissemination 6 months after termination of the program. If it has been accepted for publication, dissemination is withheld until publication permits its handling as a reprint.

e. *Reprints.* By research grants regulations, the principal investigator is required to provide reprints of publications of all work done under program support. This material is available in the open literature.

f. *Ancillary Information.* This is information that has bearing on research supported under the program, and may be extracted from reports or publications available to the Research Grants Staff, but not necessarily contained in a grants report.

2. STORAGE OF TECHNICAL MATERIAL IN THE SYSTEM

The first phase of this system employs a 5- by 8-inch file storage facility. The following items are stored into the system:

a. *Notice of Research Proposed (NRP).* This form is originally contained on an 8- by 10-inch sheet and is folded to 5- by 8-inches.

b. *Summaries of Research Performed.* When these become available, they are folded and inserted in the file.

c. *Abstracts of Reprints.* These are generally prepared by the investigator, and are reviewed by the Research Grants Staff. Storage of these and of items d, e, and f below will

be discussed in a later section, entitled "Specific Coding Procedure."

d. *Abstract of Yearly Progress Reports.*

e. *Abstract of Final Progress Report.*

f. *Ancillary Material.*

3. CODING TO PERMIT RETRIEVAL

Coding is the crux of scientific information retrieval and uses the index "Research Areas Supported by DRH," since this classification delineates the areas in which the Division has authority to fund grants. A manual entitled "Content of Areas Supported by DRH" was prepared, describing in detail the categories included and excluded, to provide clarification when needed. In a blind control check, excellent agreement was obtained between our initial coding and a recoding at a later date.

Three classification codes are used: a primary, a secondary, and a tertiary group of subjects or interests. A research grant may overlap several subject areas, or the investigator may emphasize one at the start of a project and then shift his emphasis. Thus, it may come about that the first subject code of a reprint may not be the same as that of the grant application or the progress reports. By having three subject codes, it is possible to gain access to information from different directions. The examples to follow illustrate the application of the coding method.

A general outline of the coding system is provided in appendix 1.

4. SPECIFIC CODING PROCEDURES

Upon receipt of a reprint, yearly progress report, or final progress report, an abstract is prepared on a manifold form, PHS 1397, entitled "Reference Index," figure1. This form of 5- by 8-inch size provides a yellow original, and green, blue, pink, white, and salmon carbon copies. These copies are used as outlined below:

Copy	*Filing Instructions*
Yellow	For preparing reprint list
Green	Alphabetical by principal investigator
Blue	Numerical by Code No. (ADP)—First subject
Pink	Numerical by Code No. (ADP)—Second subject
White	Numerical by Code No. (ADP)—Third subject
Salmon	Numerical by Research Grant No. (RH No.)

The important guidelines evolved for coding are listed below:

a. Each grant application is coded but only the first subject is used in automatic accounting procedures.

—

Title **Strontium-90 Content of Human Incisors** RH 00112 (RAD)

Author **Rosenthal, Harold L. and Others**

Subject

____ **222331**

____ **110331**

____ **333333**

Ref. Source **Journal of Oral Therapeutics and Pharmacology, Vol. 1, No. 2**

Filed **February 1965**

Summary **The concentrations of strontium-90 in deciduous incisor teeth of bottle-fed children born in St. Louis increased from 0.18 pC/gram calcium in 1949 to 2.56 pC/gram calcium in 1957. The greatest rate of strontium-90 deposition occurred between 1954 and 1955 following extensive atomic testing which began in 1953. A comparison is presented in Sr-90 value of breast or bottle-fed babies. Sr-90 values for dentin and enamel are given. Correlation of teeth to bone Sr-90 is arrived at.**

This data suggests that human teeth are useful as an index of Sr-90 accumulation and body burden during the time the teeth are formed.

PHS-1397
REV. 1-56 REFERENCE INDEX

Figure 1. Example of a completed Reference Index

b. NRP and Alternate NRP (privileged information) are filed by grant number only and not coded. When an NRP is not available, an abstract is prepared and entitled "Alternate NRP."

c. Summaries are dated, noted as to RH number, trimmed, folded to 5- by 8-inches, and filed under the subject code.

d. Publications are dated, abstracts are typed on the Reference Index Form (fig. 1), and filed under principal investigator, subject code, and RH number.

e. Final progress reports are abstracted, typed on the Reference Index Form, and filed under principal investigator, subject code, and RH number.

Privileged information is so designated on the Reference Index Form, with date of receipt of information.

The first subject code is also entered on the data processing cards prepared by the Office of Resource Development (ORD). A 6-digit area, composed of a 3-digit field, a 2-digit field, and a 1-digit locator, has been allowed for the coding. The procedure adopted it as follows:

The first 3 digits (the Primary Code, table 1), are used in the classification of subject categories. Essentially, these are related to program interest. The fourth and fifth digits (the Secondary Code, table 2) deal with broader classification concepts and have been designated on the form as "Area of Emphasis" and "Discipline," respectively. These refer to the nature of the study subject and to the means used in the conduct of the investigation. The fourth and fifth digits are considered to contribute to a "matrix" concept, which will be discussed below.

The sixth digit is either a 1, 2, or 3, and is used to categorize the report using a second or third frame of reference. In selecting one of the secondary or tertiary frames of reference for coding purposes, the report will commonly be given a code number that will differ, with respect to the primary coding (first three digits), and possibly even the secondary coding (fourth and fifth digits), from its initially selected code. In this way, a given document may be classified by way of more than one entry.

The matrix concept derives from the use of the two-item index, digits 4 and 5, which is independent of the standard pyramidal or hierarchical index related to "Research Areas Supported by DRH". This secondary index is broad enough, and sufficiently suited to our needs to enable us, for certain types of inquiry, to retrieve applicable information through this index alone, ignoring the prime index.

Table 1. Primary code—scientific content of research grants

		Number
I.	Effects of Radiation on Man and Matter	100
	A. Human Epidemiology Studies	110
	B. Radiation Physics and Chemistry	120
	C. Supportive Radiobiological Studies	130
	1. Genetic Radiation Effects	131
	2. Somatic Radiation Effects	132
	3. Aging due to Radiation Damage	133
	4. Radiation Damage Mechanisms	134
	5. Modification of Effects and Uptake Mechanism	135
II.	Measurement of Radiation Exposure	200
	A. Methodology and Instrumentation	210
	1. Exposure Measurement	211
	2. Dosimetry Development	212
	B. Population Exposure	220
	1. X ray	221
	2. Fallout	222
	3. Naturally Occurring Radioactivity	223
	4. Clinical Procedures	224
	5. Nuclear Installations	225
III.	Development of Methodology for Exposure Reduction and Control	300
	A. Studies of Environmental Pathways	310
	1. Terrestrial and Fresh Water Environments	311
	2. Marine Sciences	312
	3. Atmosphere—Radioactivity and Fallout	313
	B. Studies of Protective Action in Environmental Contamination	320
	1. Agricultural Practices	321
	2. Food Processing and Ion Exchange	322
	3. Waste Disposal	323
	C. X-ray Exposure and Radionuclides	330
	1. X ray	331
	2. Fluoroscopy	332
	3. Radionuclides	333
IV.	Others	400
	A. Radiation Meetings and Conferences	410
	1. Meetings held in United States	411
	2. Foreign Meetings	412
	B. Nonionizing Radiation	420
	1. Maser	421
	2. Laser	422
	3. Ultraviolet Light	423
	4. Biomagnetics	424
	5. Low Frequency	425
	6. Others	426
	C. Beneficial Applications	430
	1. Sanitation	431
	2. Food Preservation	432
	3. Agriculture	433
	4. Others	434

5. RETRIEVAL METHODS

Retrieval of information is normally accomplished by extracting the primary code (pyramidal categories) for the required information from the pyramidal index searching in the first 3 positions. There is no consideration given as to whether it is the first, second, or third subject (which is categorized in position 6) and only the first three positions in this case are searched. If the search or information required is of the type that is broad and cuts across several areas or categories, then a code is extracted from the broad index and the fourth and fifth positions are searched. Utilizing a pyramidal index and a horizontal index to give a matrix and three subject orders allows this system a great capability for information retrieval. It does not preclude the use of a strictly manual or an assisted manual method (for example, keysort system), but at the same time the coding system remains available for automatic data processing.

For our purpose, a 6-position or 6-digit code was allowed by the Office of Resource Development which does the budgetary accounting. Therefore, we were required to restrict ourselves to the 6-digit code. Since in our work there is occasion to search by a broad or "across the categories" type of search (by considerations of broad disciplines), it was necessary to incorporate the second

Table 2. Secondary code—general area of emphasis and discipline

AREA OF EMPHASIS	Code number for fourth position
A. *Assessment of Hazards*	
1. Analysis and Measurement	1
2. Reaction with Environment	2
3. Biological Effects and Epidemiology	3
B. *Control Hazards*	
1. Standards and Indices	4
2. Principles of Control	5
3. Design of Systems	6
4. Management	7
C. *Basic Data*	8

DISCIPLINES	Code number for fifth position
A. *Chemistry* (including biochemistry)	1
B. *Physical Sciences* (including mathematics and engineering)	2
C. *Biological and Medical Sciences*	3
D. *Sociological and Economic Sciences*	4
E. *Other*	5

code in the fourth and fifth positions. It was also thought that at a later date, a finer pyramidal index would be required; this could be accomplished by using 7, 8, 9, or more positions (appendix). It is true that this would not fit into the ORD system, but a retrieval system could easily be utilized without negating the ORD budgetary information. At the present time, this is not necessary, although it is available for future use.

EXAMPLES

Example 1. Primary Code Emphasis. If an inquiry should come in regarding the neurological effects of low-level radiation on primates or man, reference is made to the primary code. From this we would extract the following: I, Effects of Radiation on Man and Matter; C, Supportive Radiobiological Studies; and 2, Somatic Radiation Effects. It is to be noted that, although the primary code tabulation lists roman numeral, alphabetic and arabic numeral entries, the document always appears in arabic numbered form. Thus, this example would result in the code number 1-3-2, or 132.

By going into the content of the subject classification areas, it is possible to recheck to make certain that the proper selection was made. By then searching in the first three places for the code number 132, all grants or all printed materials dealing with the subject are referred out-or printed out. As long as the number of entries under this code number is small, a hand-sorting procedure will suffice to produce the documents dealing with the specific subject of inquiry.

Example 2. Secondary Code Emphasis. In the case of an inquiry which might perhaps be based on policy, program, or feasibility considerations, the code for Area of Emphasis and Discipline becomes the frame of reference.

For example, where a publication results from a grant dealing with genetic radiation damage, primary code number 131 would be assigned. In assigning the code, the number would be, tentatively, 131xx1. There remains the need for coding with respect to place 4, "Area of Emphasis," and place 5, "Discipline." If the publication describes methods of analysis and measurements of genetic radiation damage, the number "1" is assigned to the fourth place. If the research is performed within the disciplines of the biological or medical sciences, the fifth position would receive the code number "3," and the entire code would be 131131.

Example 3. Application of Sixth Digit. In the case just cited, a secondary emphasis could apply, such as Radiation Damage Mechanisms. In this instance, the number 2 appears as the sixth digit,

indicating that it is a second frame of reference. At the same time, the primary code number requires changing. The resulting code number, derived from the applicable listing of subjects in table 1, is 134132.

Revision for additional positions

As mentioned previously, growth of the system may require the addition of positions to the existing coding system. Coding for positions 7 through 9 may be achieved by utilizing the "Auxiliary Coding of Scientific Content of Research Grants" provided in the appendix. This auxiliary code provides a more detailed breakdown of information content.

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APPENDIX

AUXILIARY CODING OF SCIENTIFIC CONTENT OF RESEARCH GRANTS

110 HUMAN EPIDEMIOLOGY STUDIES

–01 X-ray Studies
- 1 Diagnostic studies on adults
- 2 Diagnostic studies on children
- 3 Therapeutic work on adults
- 4 Therapeutic work on children
- 5 Radiologists
- 6 Studies on children irradiated in fetal stage

–02 Occupational Hazards Excluding Radiology
- 1 General nuclear industrial exposure
- 2 Plutonium
- 3 Uranium

–03 Radionuclide Studies
- 1 Thorotrast
- 2 Iodine 131

120 RADIATION PHYSICS AND CHEMISTRY

–01 Bioenergetics and Biophysics
- 1 Photosynthesis
- 2 DNA and RNA studies
- 3 Cellular organelles
- 4 Mathematical biology
- 5 Electron paramagnetic resonance studies
- 6 Nuclear magnetic resonance studies
- 7 Colloidal studies

–02 Intermediary Metabolism
- 1 Anaerobic cycles
- 2 Aerobic cycles
- 3 Mechanism of enzyme action
- 4 Proteins and protein metabolism

–03 Cell Physiology and Biochemistry

1 Membrane phenomena and transport mechanisms
2 Cyto- and histochemistry (including electron microscopy)
3 Labeled tracers for cell studies and autoradiography
4 Trace mineral studies
5 Antigen-antibody research

131 GENETIC RADIATION DAMAGE

–01 Cytogenetics

1 Production of abnormal chromosome constitutions in mammalian cell cultures
2 Structure and function of chromosomes under normal conditions and under radiation and other physical and chemical stresses
3 Plant studies on Tradescantia, Neurospora, and so forth

–02 Microbial and Biochemical Genetics, and Gene Action

1 Microbial and phage genetics
2 Biochemical genetics
3 Gene action

–03 Human and Mammalian Genetics

1 Determination of mutation rates in normal populations
2 Studies on Hiroshima and Nagasaki populations
3 Studies on genetic diseases of man
4 Studies on genetic diseases of domesticated and laboratory animals
5 Studies on clinically irradiated populations

–04 Population Genetics

1 Theoretical models of the mutation flow process
2 Application of statistical calculations to population problems
3 Drosophila population studies

–05 Molecular Radiation Genetics

1 Physics of energy transfer in combination with the molecular chemistry of genetically important materials
2 Development of protective agents against initial genetic damage

–06 Mutation Rate Analysis

1 Quantitative determinations of mutation rates induced by X rays, gamma rays, and particulate emissions
2 Study of the frequencies of different types of individual mutations

3 Comparison studies on exposure to low intensities over a lifetime with large exposures briefly delivered
4 Development of mutation rate prediction equations for man and the domestic animals

132 SOMATIC EFFECTS OF RADIATION

–01 Acute Whole-Body Irradiation Effects
1 Determinations of acute lethal dose
2 Clinical symptoms of radiation sickness in humans (therapy or accident patients)
3 Immunological responses
4 LD-50 and survival tests in laboratory and domestic animals
5 Pathology of acute radiation injury
6 RBE for acute effects

–02 Chronic Whole-Body Irradiation Effects
1 Tumor and leukemia incidence
2 Immunity and infectious disease incidence
3 Degenerative disease incidence
4 Physiological capabilities
5 RBE for chronic effects

–03 Gastrointestinal System
1 Fluid and mineral concentration studies associated with damage to the G.I. system
2 Methods of alleviating damage
3 Dynamics of cell injury, destruction, and eventual repopulation

–04 Hematopoietic and Cardiovascular System
1 Studies on the modification of the blood cell-forming system
2 Studies of the effects on erythropoiesis (including effects of specific isotopes)

–05 Nervous System
1 Changes in the receptor functions of the sense organs
2 Impulse conduction in the nerves
3 Behavior patterns
4 Effects on the vascular system and other systems as they affect function of the nervous system secondarily

–06 Reproductive System
1 Effects on germinal epithelium and gametes, damage and repair processes, dynamics of cellular selection
2 Induced temporary or complete sterility
3 Effects on secondary sexual organs, endocrine function immunology, and tissue physiology

–07 Other Organ Systems
- 1 Effects on the renal system
- 2 Effects on the endocrine system
- 3 Effects on the skeletal system
- 4 Effects on the muscular system
- 5 Effects on the pulmonary system
- 6 Dermatological studies
- 7 Others

–08 Development Anomalies
- 1 Effects on the early embryo from parent irradiation
- 2 Prenatal anomalies resulting from fetal irradiation
- 3 Postnatal anomalies resulting from fetal irradiation
- 4 Postnatal anomalies resulting from parent irradiation

133 AGING DUE TO RADIATION DAMAGE

–01 Gross Studies on Whole Animals

–02 Cellular Studies

–03 Macromolecular Studies

–04 Lifespan Studies

134 RADIATION DAMAGE MECHANISM

–01 Radiobiological Studies
- 1 Peroxide formation
- 2 Charge transfer
- 3 Radiolysis of water

135 MODIFICATION OF EFFECT AND UPTAKE MECHANISM

–01 Protective Agents
- 1 Chemical agents
- 2 Physical factors
- 3 Germ-free colony studies

–02 Facilitation of Recovery
- 1 Bone marrow, spleen and liver transplants to promote bone marrow recovery
- 2 Use of antibiotics
- 3 New approaches to facilitate recovery

–03 Removal of Radioactivity
- 1 Development and testing of chelating agents
- 2 Mineral metabolism studies on the factors controlling deposition and mobilization of bone

–04 Radiation Synergism
- 1 Chemical agents
- 2 Physical factors
- 3 Biological factors

–05 Studies on Radioresistance
- 1 Mechanisms in bacteria, yeast, and plants
- 2 Mechanisms in invertebrates
- 3 Mechanisms in vertebrates

–06 Uptake Distribution, Deposition, and Elimination
- 1 Kinetics of uptake, distribution, deposition, and elimination following isotope administration
- 2 Observations on sites of deposition of administered radioisotopes
- 3 Influence of chemical and physical parameters on deposition and fate
- 4 Influence of physiological and pathological parameters on deposition and fate

310 STUDIES OF ENVIRONMENTAL PATHWAYS

–01 Terrestrial and Freshwater Ecology
- 1 Plant and animal systems
- 2 Soils, plants, and soil-plant relations
- 3 Freshwater systems

–02 Marine Sciences
- 1 Biological uptake, concentration, distribution, and effects of radioactive elements
- 2 Sedimentation
- 3 Circulation and mixing
- 4 Other studies (including oceanographic)

–03 Atmospheric Radioactivity and Fallout
- 1 Atmospheric chemistry
- 2 Atmospheric dynamics
- 3 Fallout formation and source effects

–04 Radioactivity in Soil, Food, and Man
- 1 Whole-body counting of man
- 2 Tooth and bone studies for Sr-90
- 3 Surveys on dietary contamination
- 4 General studies

–05 Geological Research
- 1 Natural background surveys
- 2 Studies on various geological formations for artificial and natural background radiation

THE ABSTRACT CARDS accompanying this report are designed to facilitate information retrieval. They provide space for an accession number (to be filled in by the user), suggested key words, bibliographic information, and an abstract. The key word concept of reference material filing is readily adaptable to a variety of filing systems ranging from manual-visual to electronic data processing. The cards are furnished in triplicate to allow for flexibility in their use.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1967—O 232-256

ENVIRONMENTAL HEALTH SERIES

Radiological Health

The following technical reports issued by the Division of Radiological Health are available through the Public Inquiries Branch, Office of Information, Public Health Service, U.S. Department of Health, Education, and Welfare, Washington, D.C. 20201.

PHS Pub. No.	Title
999–R–1*	Factors Influencing Strontium-90 in Milk from the Brainerd, Minn., Milkshed
999–R–2	Rapid Methods for Estimating Fission Product Concentrations in Milk
999–R–3*	Studies of the Fate of Certain Radionuclides in Estuarine and Other Aquatic Environments
999–R–4	Mathematical Programming Models for Selection of Diets to Minimize Weighted Radionuclide Intake
999–R–5	Radionuclide Analysis of Gamma-Ray Spectra by Stepwise Multiple Regression
999–R–6	Farming Practices and Concentrations of Fission Products in Milk
999–RH–7	An Environmental Surveillance Laboratory for Radionuclide Analyses
999–RH–8	X-Ray Equipment Survey in Polk County, Florida—September 1961–August 1963
999–RH–9	An Emanation System for Determining Small Quantities of Radium–226
999–RH–10*	Procedures for Determination of Stable Elements and Radionuclides in Environmental Samples
999–RH–11	Radiochemical Determination of Uranium in Environmental Media by Electrodeposition
999–RH–12	Radioactive Decay Correction Factors
999–RH–13	Behavior of Certain Radionuclides Released into Fresh-Water Environments—Annual Report 1959–1960
999–RH–14	Iodine 131 in Children's Thyroids from Environmental Exposure
999–RH–15	Quality Control of Radioactivity-Counting Systems
999–RH–16	Medical Uses of Radium and Radium Substitutes
999–RH–17	Radionuclide Analysis of Large Numbers of Food and Water Samples
999–RH–18	Mortality of New England Dentists 1921–1960
999–RH–19	Soil and Sediment Analysis: Preparation of Samples for Environmental Radiation Surveillance
999–RH–20	Standards of Performance for Film Badge Services
999–RH–21	A Computer Program for the Analysis of Gamma-ray Spectra by the Method of Least Squares

*Out of print. Copies may be obtained from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

SABO, J. J., and S. WIEDER: Scientific information retrieval system for research grants, Division of Radiological Health.

U.S. Department of Health, Education, and Welfare, Public Health Publication No. 999-RH-22 (1966), 17 pp. (limited distribution).

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